Development of Novel Biodegradable Bioplastics Using Mango Peels Intended for Packaging Film

Wang, Alyssa (School: East Ridge High School)

Implementation of biodegradable, eco-friendly, sustainable bioplastic films derived from fruit peels not only solves the issue of greenhouse gases emitted by disposed fruit waste in landfills but also minimizes the pollution and health concerns caused by petroleum-based plastic. In this study, bioplastic film produced from mango peels was developed through an environmentally-friendly, aqueous, acid hydrolysis process using a 5% acidity vinegar solution. The film properties, including roughness, transparency, thickness, tensile strength, elongation, water vapor transmission rate, degradation, and water resistance, were characterized, and the mechanical performance was optimized through the hydrolysis temperature, duration, and the plasticizer type and concentration. Mango peels were found to form bioplastics film with best surface morphology and tensile strength after 48 hours of hydrolysis at 50°C. Furthermore, the effects of three plasticizers–glycerol, polyglycerol-3, and polyglycerin-10–were assessed on their ability to improve elongation and elasticity, and the best results were obtained using 20% of polyglycerol-3. When the film was dip-coated in a hydrophobic solution, a novel surface modification method, the water resistance was significantly enhanced, as evidenced by the improvement of the water vapor transmission rate and the water contact angle. The degradation of the film was evaluated by placing the films in soil and studying the changes weekly. Adding chitosan, a natural biodegradable polymer, to inhibit bacterial growth was also explored. Results showed the developed bioplastic film had tensile strength equivalent to commercial petroleum-based plastic food wrap, was biodegradable, bacteriostatic, and has the potential to be used as packaging film.

Awards Won: